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The title of this series is Resource Recovery Plant Implementation: Guides for Municipal Officials. The parts of the series are as follows:

1. Planning and Overview SW-157.1)
2. Technologies (SW-157.2)
3. Markets (SW-157.3)
4. Financing (SW-157.4)
5. Procurement (SW-157.5)
6. Accounting Format (SW-157.6)
7. Risks and Contracts (SW-157.7)
8. Further Assistance (SW-157.8)

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RESOURCE RECOVERY PLANT IMPLEMENTATION:
GUIDES FOR MUNICIPAL OFFICIALS

ACCOUNTING FORMAT

by David B. Sussman*

The economics of various types of resource recovery systems are difficult to compare. System technologies vary, capital and operating costs vary, revenues from the recovered products vary, the recovered products themselves vary, and the cost accounting methods used to analyze system economics vary. This paper proposed a method of reporting costs and revenues to aid in comparing the costs of various resource recovery systems. The proposed method includes a standardized accounting format and a normalized accounting format.

The standardized accounting format facilitates comparison and analysis of resource recovery plant costs and revenues by assuring that all cost and revenue elements are included (or at least that the exclusion of certain items is identified). Whether based on historical or projected data, the standardized accounting format is designed to reflect the costs and revenues of a system, incorporating all site-specific parameters.

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The normalized accounting format reflects all costs and revenues for a system, but it is not site specific. General assumptions for certain costs and revenues are used. Normalized accounting information is used to compare systems when site specific information is unavailable, or when one wants to compare costs of different systems. The normalized accounting format preserves and highlights the differences resulting from engineering design while eliminating differences resulting from site-specific factors.

The accounting format is presented on the following seven tables. Each item on the tables is explained in the notes following the tables; the numbers in parentheses on the tables match the numbered notes. Those costs that cannot be segregated (e.g., design, construction, real equipment) should be combined and labelled accordingly.

The Office of Solid Waste Management Programs (OSWMP) has developed these recommended cost accounting formats as a means of assisting planners, designers, and decision making officials in their resource recovery decisions. Other cost accounting formats available from OSWMP include collection, incineration, sanitary landfill and shredding. OSWMP invites users of these formats to forward the data developed along with a designation of they system to OSWMP so that we will be able to compile data from most of the systems for use by other planners.

TABLE I

CAPITAL COSTS - ACTUAL
(COST IN 19__ $) (1)

Land		$____	(2)*
Site Preparation		____	(3)
Design		____	(4)
Construction		____	(5)
Real equipment, including replacements		____	(6)
Other equipment, including replacements		____	(7)
Contingencies		____	(8)
Start up and working capital		____	(9)
Financing and legal		____	(10)
Total initial capital investment		$____	(11)
Estimated useful life of facility	(years)	____	(12)
Total interest to be paid		____	(13)
Total capital cost		____	(14)
Average annual capital cost		____	(15)
Annual throughput (tons)		____	(16)
Capital cost per ton		$____	(17)
		(To Table VII)	

Sources of capital (list):

Source	Amount	Interest rate or return on investment	Period
Total	____ (18)		

Throughput calculation: (16)

(Design throughput, daily) x (% availability) x (days per week) x 52 weeks per year = (tons/year)

*Numbers refer to notes.

TABLE II

ANNUAL OPERATING AND MAINTENANCE COSTS - ACTUAL
(COST IN 19__ $) (1)

Salaries	$____	(19)
Employee benefits	____	(20)
Fuel	____	(21)
Electricity	____	(22)
Water (and sewer)	____	(23)
Maintenance	____	(24)
Replacement equipment	____	(25)
Residue removal	____	(26)
Other overhead	____	(27)
Taxes and licenses	____	(28)
Insurance	____	(29)
Management fees	____	(30)
Professional services	____	(31)
Total annual operating and maintenance costs	$____	(32)
Operating and maintenance cost per ton	$____	(33)
	(To Table VII)	

TABLE III

PRODUCT REVENUES - ACTUAL
(REVENUE IN 19__) (1)

Recovered material	Price per ton (34)		Shipping per ton (35)		Ton of material per ton of throughput (36)	Net Revenue
Ferrous metal	$____	-	____	x	____	= $____
Glass	____	-	____	x	____	= ____
Aluminum	____	-	____	x	____	= ____
Other non-ferrous	____	-	____	x	____	= ____
Other (list)	____	-	____	x	____	= ____

Material revenues per throughput ton $_____ (37)

Recovered energy	Price per unit		Shipping per unit		Units of energy per ton of throughput	Net Revenue
___ (38)	___(39)	-	___ (35)	x	____ (36)	=_____

Energy revenues per throughput ton $_____ (40)

Total revenue per throughput ton $_____ (41)

(To Table VII)

TABLE IV

CAPITAL COSTS - NORMALIZED
(COST IN 1975 $)

Land	$____	(42)
Site preparation	____	(43)
Design	____	(44)
Construction	____	(45)
Real equipment, including replacements	____	(46)
Other equipment, including replacements	____	(47)
Contingencies	____	(8)
Start up and working capital	____	(9)
Financing and legal	____	(48)
Total initial capital investment, "N"	$____	(49)
Estimated useful life of facility (years)	____	(12)
Total interest to be paid	____	(50)
Total capital cost	____	(51)
Annual capital cost	____	(52)
Annual throughput (tons)	____	(16)
Capital cost per ton, "N"	$____	(53)

(To Table VII)

Sources of capital (list):

Source	Amount	Interest Rate	Length of financing period
Municipal bond	___ (49)	8%	20 years

TABLE V

ANNUAL OPERATING AND MAINTENANCE COSTS - NORMALIZED
(COST IN 1975 $)

Salaries	$____	(54)
Employee benefits	____	(55)
Fuel	____	(56)
Electricity	____	(57)
Water (and sewer)	____	(58)
Maintenance	____	(59)
Replacement equipment	____	(25)
Residue removal	____	(60)
Other overhead	____	(27)
Taxes and licenses	____	(61)
Insurance	____	(62)
Management Fees	____	(63)
Professional Services	____	(64)
Total annual operating and maintenance costs, "N"	$____	(65)
Operating and maintenance cost per ton, "N"	$____	(66)

(To Table VII)

TABLE VI

PRODUCT REVENUES - NORMALIZED
(REVENUE IN 1975 $)

Recovered Material	Price per ton (67)		Shipping per ton (68)		Ton of material per ton of throughput	(36)	Net Revenues
Ferrous metal	$_____	-	_____	x	_____	=	_____
Glass	_____	-	_____	x	_____	=	_____
Aluminum	_____	-	_____	x	_____	=	_____
Other non-ferrous	_____	-	_____	x	_____	=	_____
Other (list)	_____	-	_____	x	_____	=	_____

Material revenues per throughput ton $_____ (69)

Recovered energy	Revenue per unit		Shipping per unit		Units of energy per ton of throughput		Revenues
____ (70)	____ (70)	-	____ (71)	x	____ (36)	=	_____

Energy revenues per throughput ton, "N" $_____ (72)

Total revenues per throughput ton, "N" $_____ (73)

(To Table VII)

TABLE VII

SUMMARY
($ PER THROUGHPUT TON)

	Actual	Normalized
Capital costs	$_____ (From Table I)	$_____ (From Table IV)
Operating and maintenance costs	$_____ (From Table II)	$_____ (From Table V)
Total cost	$_____	$_____
Revenues	$_____ (From Table III)	$_____ (From Table VI)
Net operating cost/profit	$_____	$_____

NOTES

(1) State what year dollars are used.

(2) Total cost of land acquired for the resource recovery facility. Include transfer station land if essential part of total system. Include the capital cost of the disposal site that will take the systems residue or is required as disposal backup. This site must be large enough to dispose of all the unrecovered components of the waste stream during the lifetime of the facility. If this disposal site is used for other solid waste disposal, include only that portion chargeable to the resource recovery system.

(3) Cost of site preparation: Include cost of relocating present tenants, if applicable. Include cost of disposal site preparation.

(4) A and E or consultant costs for preliminary design, feasibility studies, final designs, checking of shop drawings, inspections during construction, preparation of operating manuals, operator training, and assistance during start-up. Explain what items are covered in this category.

(5) Construction costs: Include construction management. (Example: buildings, structures, and foundations) do include cost of replacement equipment. See Item 25.

(6) Real Equipment: Include costs of all real property installed equipment. (Example: processing equipment). See Note 25 for explanation of replacement equipment.

(7) Other Equipment: Include cost of all ancillary equipment like bulldozers, loaders, office equipment, and trucks that are necessary for plant operation. Include operating spares. Include total cost of any leased equipment, if equipment is leased in lieu of purchase.

(8) State how much capital is reserved for contingencies.

(9) State how much capital is reserved for start up and for working capital.

(10) State cost of bond counsel, legal fees, financial management consultants, etc. Also include interest on capital during construction less anticipated short term return on unspent capital.

(11) Total initial capital investment. (Sum of item 2 through 10).

(12) Designer's estimate; may be longer than financing period, but in no case will it be less.

(13) Out-of-pocket payments of interest on all debt and fair return (dividends) on equity (stock) when incurred and discounted back to the year in which the data is stated.

(14) Sum of (11) and (13).

(15) Item (14) divided by item (12).

(16) Cost per throughput ton. To determine the throughput per year take design capacity per day (indicate operating hours per day) times system design reliability or availability (percentage of available capacity) times number of days of planned operation per week times 52 weeks. Example: 1,000 tons per day X .85 (system availability) X 5 1/2 days per week X 52 weeks = 243,100 tons per year.

(17) Item (15) divided by item (16).

(18) Must equal item (11). Include both debt and equity. Interest rate would apply to debt and fair rate of return to equity. Period would be designer's life of facility for equity and length of financing period for debt.

(19) Total annual salaries. Include all personnel that are necessary for system operation. Include supervisory and administrative personnel. Do not include any collection costs (garbage trucks, etc.). Breakdown into operating personnel, maintenance personnel and administrative personnel. If maintenance labor costs are charged to maintenance so state and include in item (24).

(20) Includes employer contribution for FICA, health insurance, pensions, etc.

(21) All system fuel costs. Process, space heat, auxiliary equipment, bulldozers, loaders, etc. (an fuel usage that is charged to the resource recovery system) List by usage and fuel type.

(22) Total electric bill. Process, office, lighting, heating, auxiliary equipment, air conditioning, etc.

(23) Include process, cooling, sanitation, lawn care, wash down, boiler feedwater, etc.

(24) Include all costs, both contractor and in-house. Labor costs may be included in (19). Building maintenance should be segregated from process equipment maintenance.

(25) Include yearly expenses. Do not include inventory. Include inventory in (7). If parts and supplies are included in maintenance costs, so state. Include in this item funds that are set aside for the replacement of depreciated equipment. State what portion of this item is for parts, supplies, depreciation and so forth.

(26) List the cost of disposing of the residue. Include hauling to remote disposal site, and cost of disposal. Do not include capital cost of disposal site. On site handling should be included in items (5), (6), (7) and (19).

(27) List other overhead items.

(28) Include property tax or payment to the city in lieu of taxes, operating licenses, occupancy and utility taxes, etc.

(29) Fire, liability, etc.

(30) Payment to system operator (if applicable).

(31) Audit fees, legal fees, data processing, etc.

(32) Total annual operating and maintenance costs. (Sum of items (19) and (31).

(33) Item (32) divided by item (16).

(34) List the per ton selling price of the recovered material products. Include information on escalator clauses or specifics, such as a price that is linked to the market price of the material at a specific location. If some recovered products are sold "mixed," ie. glass-aluminum fraction, so state and list revenue for whole fraction.

(35) Freight, handling and demurrage. List the cost of shipping the product to the market. Include any cost that is charged to the system that is associated with the sale of the recovered products. Do not include those items of capital equipment such as trucks or steam lines. This transportation cost may be reflected in the sale price of the recovered item (F.O.B.). If so, state.

(36) Number of tons of each recovered product per ton of throughput.

(37) Sum of all material revenues.

(38) State what form the recovered energy is in (steam, gas, oil, shredded fuel, etc.), and in what unit it is sold (BTU, ton, pound, gal.,etc.).

(39) List the revenue per unit. Indicate any excalators and state details of how price per unit energy may be linked to a specific market, another fuel, or another energy source.

(40) Sum of all energy revenues.

(41) Sum of items (37) and (40). If applicable, list revenues other than for sale of products; e.g., charge for handling sludge, industrial waste, oversized or bulky waste, or other special waste.

(42) Calculate minimum number of acres that is necessary for plant as designed. Include disposal site as explained in item (2). Do not compress, expand or refit design when calculating minimum acres necessary. Assume $10,000 per acre.

(43) Assume 35 percent of (42).

(44) Design cost should be the same as listed in item (4).

(45) Actual construction cost adjusted to national average using standard construction cost data and civil engineering index or other standard indexes.

(46) (47) All equipment prices should be F.O.B. the supplier. Assume shipping charges are 10% of total and add to equipment costs.

(48) Assume 2% of capitalized costs.

(49) Total initial capital investment, normalized.

(50) Assume that all capital costs are financed with a 20 year municipal bond at a 8% interest. Include in item (50) the total interest paid over the 20 year period.

(51) Sum of (49) and (50).

(52) Item (51) divided by item (12).

(53) Item (52) divided by item (16).

(54) Take the total number of workers that are necessary to run the plant. This should be the same as item (19). If not, explain. Multiply this number by $15, 500 yearly salary. This cost includes employee benefits.

(55) Included in (54).

(56) List fuel use as in item (21). Assume $.60 per gallon for gasoline; $.40 per gallon for diesel fuel; $2.00 per million BTU for natural gas.

(57) Assume $.03 per KWH.

(58) Assume $.50 per KGAL.

(59) Include all costs, both contractor and in-house, but do not include in-house labor. Labor is already accounted for in item (54).

(60) Include costs as in (26). Assume final disposal cost of $4.00 per ton of residue. Assume haul distance is 5 miles.

(61) Assume .75 percent of normalized capital cost.

(62)(63)(64) Combine these items and assume $1.00 per throughput ton for all three.

(65) Total annual O and M cost, normalized.

(66) Item (65) divided by item (16).

(67) Because of the wide differences in resource recovery technologies, the output products from different systems may not at first seem comparable. However, after applying the following assumptions a rough comparison is possible. List the output material in the form that the system design will produce. ie. - #2 ferrous, mixed color glass, 90 percent pure aluminum, mixed metals - 40 percent nonferrous, etc. State the assumed solid waste composition that is used for this determination and be realistic when determining how much of aluminum, mixed metals - 40% non-ferrous, etc. Then assume the material is worth 75% of the Chicago market as of 1 April 1975 for similar material. This is the revenue earned. If there is no Chicago market for the material a judgement as to what the material is worth will have to be made. The rationale for this judgement can be included along with Table VI. The determination of product worth should consider the market price for similar products, possible letters of intent, actual sale price (if product was ever sold) and the like. Do not include shipping.

(68) Assume transportation costs of $6 per ton for glass; $12 per ton for ferrous; $20 per ton for aluminum and other materials at 25 percent of expected revenues.

(69) Sum of material revenues.

(70) Energy products are also difficult to compare. Assume the following prices for energy products.

Steam:	$1.50/1,000 pounds
Shredded Fuel:	$.45 per million BTU
Pulped Fuel:	$.50 per million BTU
Pyrolysis Gas (with useable sensible heat):	$1.00 per million BTU
Pyrolysis Gas (no sensible heat):	$1.10 per million BTU
Methane:	$2.00 per million BTU
Pyrolysis Oil:	$1.85 per million BTU
Other Chemical:	Average market price as of 1 April 1975
Electricity:	$.03/KWH

(71) Assume shredded fuel transportation costs at $.11 per million BTU; zero cost for steam, electricity, and gas (pipes and cables should be included in construction costs); oil at $.03 per gallon.

(72) Sum of energy revenues.

(73) Item (72) divided by item (16).

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